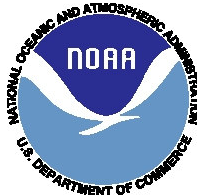


National Core Coastal Indicators Workshop
at
The Conference Center at the Maritime Institute
Linthicum Heights, MD
May 1-2, 2007

WORKSHOP REPORT

June 18, 2007

Coastal States Organization, National Oceanic and Atmospheric Administration,
U.S. Environmental Protection Agency



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Executive Summary

The National Core Coastal Indicators Workshop was initiated by the Coastal Coordination Committee (CCC), an interagency forum established by the National Oceanic and Atmospheric Association's National Ocean Service (NOAA NOS) and the Coastal States Organization (CSO). Through the CCC, NOAA and CSO partner with the Environmental Protection Agency's (EPA's) Office of Wetlands, Oceans and Watersheds, the Sea Grant Association, and other relevant officials to strengthen communication and cooperation in integrated coastal management. The CCC Indicator Working Group focuses specifically on improving coordination around indicator tracking and reporting. One goal of the Indicator Working Group was to bring indicator experts together to discuss core coastal indicators and options for developing a more coordinated and comprehensive report on the state of the nation's coasts. This workshop served as an initial step in moving toward that goal.

The workshop was held on May 1-2, 2007 in Linthicum Heights, Maryland at the Maritime Institute of Technology. Approximately 71 scientists and managers from federal and state agencies along with representatives from academic institutions, non-governmental organizations (NGOs), and various other professionals participated in the two-day workshop to discuss the development of national core indicators for monitoring the health of the United States' coastal waters.

Recognizing that numerous government agencies and NGOs have been defining and using indicators for several years, the intent of the workshop was to build on experiences, lessons learned and products generated. The following definition of "indicator" was adopted by workshop organizers and is based on the work of the Gulf of Maine Council on the Marine Environment. It was chosen because it provides a concise interpretation of an indicator. Indicators were defined as "*quantitative or qualitative measures that provide information about the status of or changes in natural, cultural and economic aspects of an ecosystem*¹."

The workshop included presentations from four speakers and a federal agency panel to provide context for workshop discussions. These presentations provided a synopsis of: 1) key issues affecting coastal areas, 2) current and emerging coastal indicator, specifically those focused on socio-economics and eutrophication, 3) indicators being monitored by federal agencies, and 4) potential strategies for public outreach. Participants were divided into five working groups to identify key coastal issues, corresponding management questions and core indicators in the following areas: Pollution, Land/Water Interface, Biological/Physical, Climate Change and Human Use. To enhance working group discussions, each group was provided with draft criteria for selecting indicators and a draft indicator framework. The framework suggested key issues and management questions and outlined commonly used indicators, existing indicator efforts at the regional and national levels, emerging indicators and a few examples of core indicators. The workshop also included plenary discussions to define target audiences and determine the best approaches for effectively communicating indicator information to illustrate the health of the national coastal ecosystem. The workshop concluded with a detailed discussion of the next steps, which included proposed actions to be undertaken by workshop organizers over the next six months.

Workshop participants identified and explored critical issues during their two days of discussions including the importance of monitoring status and trends as well as identifying contributing factors behind changes in coastal condition (i.e., pressures on the system). Some participants voiced concerns about the challenges of identifying the state of the coast at a particular point in time due to limitations in funding for national monitoring programs. Participants also maintained that there needs to be periodic user feedback to ensure that indicators remain useful over time.

Participants identified the primary audience for the indicators as Congress members and staff, government agencies, and the general public. They noted specifically that key decision-makers and champions within these groups should

¹ A Strategy for Gulf of Maine Ecosystem Indicators and State of the Environment Report.

be targeted. Participants also cited the need to move beyond just reporting the coastal condition to affecting behavioral change in policy-makers within Congress (i.e., to influence national policy) and their constituency. Key questions raised were: How do we inform and influence? How can we drive change? How is indicator information being used? How do we better reach the target audiences with messages?

A majority of the group felt that even if indicators are reported nationally, reporting also must include a regional analysis since most management decisions occur at regional and state levels. Even though Congress is a target audience, congressional leaders also respond to the concerns of their state and local constituencies. In addition, several participants maintained that indicators should be explained in the context of the entire ecosystem and desired goals of future conditions (e.g., Are we protecting sufficient habitat to provide human services?). To accomplish this, bilateral efforts to develop indicators with Canada and Mexico are needed as ecosystems do not respect national boundaries.

In terms of how the message is communicated, participants emphasized the importance of providing examples of key indicators and how they are used in the regional and local context. This is critical because national indicators do not adequately reflect regional and local indicator development. In order to effect change, it was recognized that the message must evoke concern but not fear or despair in the target audience. It was suggested that this could be accomplished using a compelling story, as illustrated by the National Park Service (NPS) to promote its national parks. The Florida Everglades and Chesapeake Bay were offered as compelling examples in the coastal environment because they are areas where there has been a great deal of publicity surrounding the value of these ecosystems and restoration efforts. Participants also stressed that both ecological and socio-economic indicators must be considered to move toward a more comprehensive assessment of coastal resources, uses and values. These ideas should be reflected in National Coastal Condition Reports (NCCR) and other communications materials.

Some key next steps identified beyond the workshop include 1) developing a communications strategy with the help of public relations experts to identify visually compelling means to convey the state of the coast to coastal managers, policy makers and their constituency; and 2) achieving buy-in from state agencies and partners to promote development and support for national core indicators through a series of nationwide outreach meetings. In addition, workshop organizers presented a six month action plan which entailed producing a final workshop report by June 2007, follow up discussions to help refine suggested indicators generated through this workshop to take place during the Coastal Zone Conference in July, 2007 and continued efforts to build support both internally, within federal agencies, and externally, with state and local partners, to improve indicator quality and usefulness.

Key Management Issues, Management Questions & Possible Core Indicators

The following Key Management Issues, Questions and corresponding Core Indicators were derived from working group and plenary discussions and speaker presentations. Detailed summaries of the working group sessions can be found in Appendix B.

Coastal Water Quality and Contaminants

What is the status of the nation's water quality?

Indicator(s):

- Total loadings of nitrogen and phosphorus
- Total nitrogen
- Total phosphorus
- Chlorophyll-a
- Macrophytes
- Dissolved oxygen
- Submerged aquatic vegetation (SAV; not useful in Great Lakes)
- Nuisance and toxic algae
- Marine debris

Emerging Indicators:

- Underwater sound
- Contaminants
 - Plastic pellets
 - Nanoparticles
 - Personal care products

Air Quality (in particular atmospheric deposition)

What is the status of the nation's atmospheric quality?

Indicator(s):

- Number of Class 1 national parks (air quality rating)
- Exceedences of air quality standards days
- Airshed air quality
 - NOx (e.g., nitrate and nitrite)
 - Reduced nitrogen (e.g., ammonia and ammonium)
 - Organic nitrogen
 - Phosphorous
 - Aromatic hydrocarbons
 - Mercury
 - Visibility
 - Total atmospheric deposition in coastal waters

Emerging Indicators:

- Ocean acidification
- Ultraviolet exceedence
- Photosynthetically active radiation
- Night light issues
 - Turtle nesting
 - Migratory bird/squid fishery

Plants/Animals (e.g., healthy food web)

What are the status and trends of important coastal species populations? How do biotic assemblages (i.e. communities) change over time?

Indicator(s):

- Proportion of fish stocks overfished (i.e., sampling, two visits to every site)
- Presence of non-native species (e.g., non-native benthic species through benthic grabs, rapid assessments, need taxonomists, mining databases etc.)
- Total landings and fishing effort (i.e., commercial and recreational fisheries)
- Fish community indicator (i.e., ultimately want to measure complexity of food web and trophic structure)
- Number of threatened and endangered species (i.e., initially monitor the presence or absence of state and federal species of concern, then monitor status and trends and conduct population assessments)
- Distribution and abundance of macroalgae
- Ecosystem Integrity Index
- Benthic Index
- Reproduction
- Biodiversity
- Endocrine disrupters
- Invasive species

Aquatic Habitat (e.g., submerged and emergent benthic vegetation and vegetative and non-vegetative substrate)

How are the extent, distribution and quality of coastal habitats changing over time?

Indicator(s):

- NCCR coastal habitat index
- Benthic habitat mapping (i.e., monitor change through a random sample based approach)
- Distribution of non-native species in non-vegetative habitats (use random sample approach)
- Benthic habitat condition (substrate physical and chemical condition - region specific)
- National Coastal Assessment benthic index (i.e., Index of Biotic Integrity, infaunal invertebrates in soft sediments)
- Invertebrate community index (e.g., measure of species assemblages and community condition)

Coastal Land Use and Development

How are coastal habitats/resources being altered over time by land use change?

Indicator(s):

- Coastal land use/land cover and change over time – natural area loss and gain (including restoration)
 - Total change in impervious surface
 - Natural area loss and gain
 - Rate of land consumption/development footprint
- Submerged and intertidal land use and change
- Habitat quality (i.e. monitor invasive species, fragmentation, connectivity, biodiversity, and rare, threatened and endangered species)
- Resource quality and quantity

How much development is occurring in coastal areas (including a subset of high hazard areas)? How is development exacerbating vulnerability or exposure to hazards/erosion?

Indicator(s):

- Number of people living in high hazard areas and change over time (possibly using Federal Emergency Management Agency (FEMA) flood maps and the number and extent of hurricanes, tsunamis, erosion hazards and landslides, etc.)
- Number/value of structures in high hazard areas from census data
- Economic value and loss due to hazards in high hazard areas

- Repeat claims for damage
- Number lives lost or displaced
- Evacuation time
- Storm frequency
- Number/percent of structures damaged
- Public spending in high hazard areas
- Percent of coastline/communities that have enacted hazard mitigation policies
- Number of communities that have adopted setback policies or stronger building codes to reduce vulnerability/risks to coastal hazards
- New insurance policies written within floodplain areas
- Extent and loss (change) of natural features that protect the coast/resources within high hazard areas (loss of barrier islands, mangroves, primary/secondary dunes, wetlands, presence or absence of seagrass beds)

Climate Change

How much of the nation's coastal areas (natural and built) are vulnerable to the effects of climate change? What is the capacity to adapt? Does the current condition of coastal areas allow habitats to adapt to changing conditions? Are coastal areas able to adapt to climate change? Have intertidal areas been hardened? Will these areas be able to migrate to accommodate sea level rise?

Indicator(s):

- Sensitivity index – shoreline vulnerability to climate change. (e.g., atlas.nrcan.gc.ca; the “Atlas of Canada” reports on relief, geology, coastal landform, sea-level tendency, shoreline displacement, tidal range and wave height)
- Percent of hardened shoreline
- Natural coastal buffer (e.g., undeveloped dunes and shorelines)
- Infrastructure investments – amount of infrastructure that would be affected by sea level rise
- Shoreline/beach width
 - Sea level rise
 - Inundation frequency
- Seagrass/marshgrass – extent and phenology

What are the impacts of climate change on commercial fisheries, growing coastal populations, timing and magnitude of freshwater flow into estuaries, weather patterns, human communities (i.e., sea level rise, coastal storms, etc.), economic activities and human use of coastal areas (i.e., recreational, agricultural, etc)?

Indicator(s):

- Sea ice extent and timing
- Sentinel species – corals (respond to: pH, temperature, disease, reef community structure); non-natives
- Fish/shellfish disease – May have multiple impacts; for higher level organisms, the disease may show effects before the temperature change
- Riverine flow input and timing
- Sea surface temperature, coastal temperature
- Ocean acidification
- Distribution of humans (in key areas a certain distance from the coasts)
- Awareness/response capacity

Commercial Fishing and Aquaculture

Are fisheries sustainable? What is the value of coastal fishing? How has it changed? How important is domestic commercial fishing to domestic consumption? Is there diversity in the fishery (in vessel size and gear type)? What is the contribution of commercial fishing to the gross domestic product (employment or sales)? What are bivalve harvests (extremely dependent on water quality)?

Indicator(s):

- Value of fisheries
- Average wage/income from fisheries and aquaculture

Recreational (e.g., diving, boating, swimming, fishing)

What is economic value of coastal recreation? Who enjoys these values? How have historic cultural resources changed?

Indicator(s):

- Distance traveled to natural area/greenspace
- People per acre (value question: which is better, density or rural character)
- Number of visitations and people who use coastal areas and beaches per year (distance between public access sites)
- Number of states that require public access
- Number of tourists to coastal regions per year

Human Health

What are the human health threats due to coastal pollution? Are contaminants affecting seafood safety and environmental quality? Is the nation's seafood safe to eat?

Indicator(s):

- Beaches (e.g., closures due to water quality problems, visitation and use, public access, tourism, etc.)
- Amount and extent of impaired waters (EPA's 303D list, Clean Water Act)
 - Number of illnesses associated with harmful algal blooms
 - Number of illnesses associated with contaminated water contact
- Shellfish closures
- Fish contamination
 - Fish consumption advisories – number of fishery advisory days
 - Bird egg contaminants
 - Marine mammal contaminants
 - Number of people who get sick from eating contaminated seafood each year
 - Possible advantages: benefits of eating fish (e.g., omega 3s)

Population, Demographic Change, and Housing

What proportion of the population lives on the coast because it's the coast? How is the quality of life being altered over time by coastal land use changes? (i.e., community change (incl. traditional uses), access change, are coastal communities still inherently coastal? How does land use affect this?

Indicator(s):

- Decrease or increase in coastal shoreline population
- Miles of undeveloped shoreline
- Coastal Livability Index
 - Percent of coastal residence in various quartiles of income (affordability)
 - Coastal property values and/or tax assessment (in terms of affordability)
 - Year-round versus seasonal residence or percent of owner-occupied homes

Employment (ocean-dependent, census level)

What percentage of the coastal population is employed in coastal related jobs? What is the income derived from coastal related jobs?

Indicator(s):

- Coastal Livability Index
 - Car miles driven (commuting)
 - Number and type of jobs available for all economic strata
 - Employment income versus investment income
 - Mix of employment opportunities along the coast and changes in mix over time
 - Average wage/income by sector

Education

How important is the coast to Americans?

Indicator(s):

- Number of publications associated with the coast
- Amount of research funding at coastal institutions
- Level of public participation in coastal education
- Change in K-12 coastal education programs attendance

Research

How many cooperative research grants have been funded? How has the consideration/use of local ecological knowledge by the scientific community changed? How has the amount of collaborative research changed?

Indicator(s):

- Number of cooperative research grants funded

Coastal Governance

How has the scale of coastal governance changed? (federal/local versus regional)

How has participation and representation of Fishery Management Councils changed?

Indicator(s):

- No indicators identified

Workshop Summary Report

Overview

Over the course of two days, a group of scientists, managers and interest groups from diverse backgrounds came together for a series of presentations and discussions focused on producing core coastal indicators at a national scale. Their purpose was to provide direction on the development, interpretation and use of national core coastal indicators to tell a more coordinated and comprehensive story about the state of the nation's coasts.

The workshop sought to build upon existing efforts to define a suite of core indicators that could be used to assess ecosystem condition and measure the overall success of management efforts by:

- Determining leading issues and threats to coastal ecosystems
- Examining current and emerging indicators for coastal assessments at local, regional, national and international levels
- Identifying core indicators of coastal ecosystem conditions
- Identifying gaps, additional research and/or new indicators to provide further data and information in addressing leading issues

In addition, workshop participants

- Discussed messages and target audiences for national core coastal indicators
- Discussed emerging data coordination and monitoring efforts as well as challenges of current monitoring efforts
- Considered whether there is a need to expand the scope of the NCCR or other federal reports

The workshop was structured so that the morning of the first day consisted of a series of presentations by invited speakers. These presentations laid the groundwork for later discussions and touched on indicator work in Canada, socio-economic indicators, emerging indicators and the communication of indicators. Following the invited presentations, representatives from four federal agencies: EPA, NPS, NOAA, and the U.S. Fish and Wildlife Service (USFWS), spoke about indicator work and monitoring efforts within their agencies. The afternoon of the first day and the morning of the second day were spent in working groups identifying key management issues, questions and core indicators in five topic areas. The target audiences for the national core coastal indicators and methods of communicating these indicators to the target audiences were discussed at the end of the working group discussions (detailed working group summaries are included in Appendix B). The second day ended with an all-group session summarizing and discussing the working group findings and communication strategies. Presentations also were given by federal agency heads who provided input on how the workshop findings could best inform the next NCCR. Finally, at the end of the workshop, steps for future action were discussed.

Speaker Presentations

Four speakers were invited to provide presentations at the beginning of the meeting to share their expertise with the group establish a common foundation for the workshop and stimulate participants' thinking about indicators. The first speaker was Dr. Barbara Buckland, who spoke about indicator efforts in Canada. The second speaker, Dr. Hans Paerl, gave a presentation about emerging indicators, focusing on eutrophication. Dr. Linwood Pendleton reported on the use of socio-economic and human use indicators for evaluating coastal and ocean health, and finally Dr. Richard Kool discussed the effectiveness of communication and how to properly convey a message so that it invokes the desired response.

Canadian Coastal Indicator Development

Barbara Buckland, Indicators and Reporting Specialist - Environment Canada

Dr. Buckland presented an overview of the development of national indicators in Canada. Some key goals include: developing a more complete set of national coastal indicators, expanding the coastal marine indicator component, attaining better understanding of users and their influence, creating multi-partner initiatives and expanding bi-national connections with the U.S. Three bi-national connections with the U.S. have been created in the Georgia Basin, Gulf of Maine and Great Lakes.

In addition to these three bi-national initiatives, Canada has a St. Lawrence River Program which includes five indicators for the St. Lawrence and Great Lakes region, a Large Ocean Management Area Program which developed a human activities atlas, ecosystem objectives and conservation objectives; and a National Parks program. The ecological integrity framework produced from the Parks program still is primarily terrestrial.

Two coastal condition reports recently produced included a review of the British Columbia coast and a report on Canadian waters in the northern territory. An emerging indicator developed through the latter report involved private citizens monitoring sea ice retreat. Information collected through this effort enables Canadian officials to compare changes in sea ice melting from year to year. The data pair science with local knowledge and will hopefully strengthen the validity of the reports and also engage citizens' interest. Another task undertaken by Canada was to create an "issues inventory" and catalog what indicators are reported in each relevant report across the nation.

Emerging Indicators of Human- and Climatically-Induced Change in Coastal Ecosystems

Hans Paerl, Professor – University of North Carolina, Chapel Hill

Dr. Paerl spoke about emerging indicators of human- and climatically-induced change in coastal ecosystems. He focused on eutrophication, but also cited other examples of emerging indicators including geomorphological, circulation, seagrass (higher plant/productivity), remote sensing and trophodynamics. Eutrophication (or the over-enrichment of nutrients) is the most rapidly expanding threat to coastal water quality and ecological condition. He argued that it is important to determine what the drivers are in the watershed, climate and terrestrial environments.

The Neuse River Estuary in North Carolina served as a model for demonstrating human and climate effects on a small-scale ecosystem. Neuse River Estuary is a lagoonal estuary with a water residence time of approximately one year. Thus eutrophication effects can be studied over a longer timeframe than in most estuaries where water residence time typically is much shorter. Nitrogen level was identified as a key indicator to monitor eutrophication effects for the following reasons:

- Nitrogen is a growth-limiting nutrient and human impacts often lead to increased nitrogen loading
- Fresh water brings in more nitrogen and lowers salinity; chlorophyll increases after excess nitrogen is introduced
- Salinity is layered in estuaries and dissolved oxygen lowers in bottom water (this is natural), but the excess biomass production driven by increased nitrogen eventually sinks and exacerbates hypoxia
- Hard to understand the connection between nitrogen input and hypoxia because the relationship is not very linear since temperature/salinity stratification already exists
- In the years following hurricanes, the hypoxia is higher. Fish kills also indicate hypoxia
- In years after many hurricanes, nitrogen input needs to be reduced, perhaps by as much as 30%

The North Carolina Department of Transportation ferry system was used to collect data. Data loggers were mounted on ferries to keep track of chlorophyll-a, salinity, temperature, turbidity, pH, dissolved oxygen, nutrients, E-coli and other bacteria and contaminants. To monitor the changes in nitrogen input, the ferries use photopigments, which can detect very small scale changes in concentration, to assess growth response once reduction strategies are in place. Through consistent monitoring, it was learned that nutrients can be reduced except when nature intervenes (high runoff due to large rainfall events, hurricanes, changes in weather patterns due to Climate Change, etc.). Flow level has important ramifications for where and how much zooplankton production occurs. Under high flow, diatoms grow fastest and become the only kind of zooplankton available in large quantities. There are more organisms and a higher diversity of zooplankton under lower flow conditions. When different zooplanktons are abundant in different years, this affects the entire food web.

Beyond understanding that nitrogen input can be reduced, it also was important to identify the kind of nitrogen that should be targeted (e.g., ammonium, organic nitrogen or nitrate). It was determined that the presence of ammonium contributed to the production of cyanobacteria more than other, good, types of algae (e.g., diatoms and cryptophytes). In understanding the specific kind of nitrogen preferred by the cyanobacteria, managers are able to focus on controlling this type of nitrogen through the reduction of specific sources.

Economic Indicators of Coastal Ecosystem Health

Linwood Pendleton, Associate Professor – University of California at Los Angeles

Dr. Pendleton spoke about collecting and analyzing socio-economic indicators in both California and through the National Ocean Economics Program (NOEP).

While the NOEP does a good job collecting and explaining industry data, Pendleton noted a shortcoming of the national effort in that it does not provide fine scale economic data (e.g., when there are three or fewer businesses of one type in a reporting areas the economic data for those businesses cannot be reported at that level). In addition, the NOEP does not provide data on how many homes are in the coastal area, or other factors such as the annual number of beachgoers, bird watchers, kayakers, anglers and divers.

He maintained that it would be beneficial to know who owns coastal homes, who are coastal uses, what these people contribute to the local economy and what businesses they support. In addition, it would be good to understand the economic value of these activities and what affects their value. This is especially important in situations where high economic value may have low economic impact. He suggested that the following questions can only be answered with such data: How does climate change, restoration, marine protected areas and total maximum daily loads affect home prices? How do they affect people's visitation to the coasts and specific activities? How resilient are local communities?

To answer these questions, indicators must be collected regularly, easily and rigorously. They should be unambiguous in their interpretation and linked to ecosystem health. Some sample activities and indicators that could be used are given in the following table.

"Tangible" Activities:	"Tangible" Indicators:
Commercial fishing data	Landings, revenue, # vessels/yr
Commercial passenger fishing vessel data	# trips/yr, # vessels/yr
Beach visitation	# visitors/yr
Camping park visitation	# spaces/yr
Oyster production	Annual output (volume, \$)
Housing	Permits, property tax, MLS
"Elusive" Activities:	"Elusive" Indicators:
Private recreational fishing	Bait sales
Recreational boating	Marine fuel sales
Kayaking	# rentals, # of tours, \$/year
Coastal visits	Parking data
Diving	Charters, tank fills
Surfing	Wax sales

California does not use these indicators. Instead, the Coastal Ocean Values Center (www.coastalvalues.org) collects these data in three California estuaries. The Center is initiating a nationwide set of economic indicators of coastal ecosystem health. Over the next year, 10-20 sites are being visited which overlap with the National Estuarine Research Reserve System (NERRS), National Estuary Programs (NEP) and National Marine Sanctuaries (NMS). While at each site (one month visits), workshops will be conducted to collect economic data. This work is being conducted in collaboration with NOAA Restoration Center, the National Marine Sanctuaries Program, the NOAA Coastal Services Center, the NOEP, Waterkeeper Alliance, Surfrider Foundation and Restore America's Estuaries.

According to Dr. Pendleton it is important to collect local economic information in order to understand constituents, the relative importance of coastal uses, the beneficiaries of management, marine protection and restoration, and the

value of local coastal uses. In addition, people need to feel a personal connection between themselves and the environment. The impacts of environmental change and the outcomes of management and restoration must be demonstrated to the public. If people think data being collected will affect their household, livelihood or recreation, then they might be more inclined to cooperate with data collection efforts. In order to promote the personal connection, environmental change needs to be linked to people. For example, high hypoxia in a waterbody leads to low flatfish catch by fishermen the following year. He suggested other data that also could be collected: ecological and environmental variables, weather, demographics, economics (e.g., gas price = lower visitation), regulation, restoration and climate change. Multivariate techniques capable of considering several variables at one time should be used to analyze these data.

Facts, Terror, Norms: A quick take on the inadvertent impacts of content on communication

Richard Kool, Associate Professor – Royal Roads University, British Columbia

Dr. Kool gave a presentation on the effectiveness of communication, specifically looking at the unintended impacts of communications. When sending a message, it is imperative that the sender and the receiver have the same intents, purposes and reasons. Otherwise, the message may not be accepted, or will be misinterpreted and lost. In addition, he explained the importance of the messages being presented. He maintained that there is a problem with presenting “just the facts.” Events and facts are perceived differently by different people and people discount evidence that does not “mesh” with their preconceived beliefs. In a sense, science can make controversy worse. It is much more effective to give plausible stories, rather than objective claims. Plausible stories involve the expression of beliefs and the reasons for their viability in a persuasive manner, whereas objective claims are subject to criticism and challenge.

Ernest Becker, author of *The Denial of Death*, developed the terror management theory, and determined that the idea of death haunts people more than anything else. Worldviews and self-esteem work to keep thoughts of death at bay. Relevant to indicator work, the level of CO₂ concentration in the atmosphere is, in a way, an indicator of death, thus how it is presented to the public is critical. It was suggested that to just present people with negative facts as was done with a public service message which stated that each year 3,000 kids start smoking may not be effective. It might just provide kids with incentive to start smoking if so many others are doing it.

Kool also presented “six tools of persuasion:”

- Authority - people tend to follow and obey messages from authoritarian figures
- Social proof - people will decide what to do in a situation based on what others are doing or have done
- Scarcity – items and opportunities that are scarce become more desirable
- Reciprocation – individuals have a societal obligation to repay what they have received in kind
- Consistency – people want to appear consistent in their commitments; if they commit in one form (e.g., on a survey), they might be more likely to commit in another (e.g., donations or stewardship)
- Liking – people prefer to say ‘yes’ to those they like

Federal Agency Panel Discussion

Representatives from four federal agencies (EPA, NPS, NOAA, USFWS) spoke about the indicator work and monitoring efforts within their agencies. In addition, they discussed the role of federal partnerships in indicator development and tracking as well as the benefits and challenges to indicator implementation and reporting. The Federal Panel Summary Table that accompanied this presentation can be found in Appendix A.

Barry Burgan

Senior Marine Biologist, EPA Office of Wetlands, Oceans, and Watersheds

Dr. Burgan of the EPA spoke specifically about current National Coastal Condition Report indicators. The report is a coordinated effort by the EPA, NOAA, the U.S. Geological Survey (USGS), the USFWS, coastal states, and the NEP to rate the overall condition of U.S. coastal waters. The report includes several major indices: a water quality index, a sediment quality index, a benthic index, a coastal habitat index and a fish tissue index. Using these indices, the report rates the coastal condition of each region, and gives an overall national rating of coastal condition. The last report rated the national coastal condition as “fair”. The criteria for selecting indicators in the NCCR also were discussed, and the nine primary criteria include: encompass a wide temporal and spatial scale, ease of replication,

index period stability, low year-to-year variation, regional reference, measures environmental impact, ability to be rolled-up or indexed, pre-existing monitoring for underlying indicators, and flexibility (i.e., indicators can be re-evaluated and modified). Dr. Burgan mentioned that the next NCCR to be released has already progressed too far to incorporate ideas from this workshop, but the 2010 NCCR will likely include changes stemming from the workshop.

Sarah Allen

Science Advisor, NPS

Dr. Allen spoke about the NPS' role in collecting indicators. Currently, 75 of 391 national parks include some ocean land, making coastal indicators a very important tool in monitoring the health of the parks. Accordingly, the NPS needs to strengthen partnerships as ocean parks are imbedded in larger ecosystems and the NPS is only just beginning to focus specifically on oceans. Recently, NPS created the Ocean Park Action Plan, attempting to network all ocean parks, sanctuaries, refuges and reserves. NPS also is positioned to access vast amounts of indicator data, as they do collect visitor information. These data need to be made more accessible and digestible. Once this is accomplished, NPS is a key program to facilitate the collection and exchange of stories.

Ralph Cantral

Chief, National Policy and Evaluation Division, NOAA Office of Coastal and Resources Management

Mr. Cantral from NOAA gave a brief background of this workshop's inception. The workshop started with the Coastal Coordination Committee's Working Group on Indicators, an interagency effort to strengthen communication and coordination in the coastal management community. Prior to the inception of this workshop, the Working Group had begun developing a national set of core coastal indicators to promote more efficient data collection, more consistent reporting and more coordinated management. He then spoke about how federal-state-local partnerships aid in the majority of NOAA's indicator collection. For example, the National Estuarine Research Reserve System and the Coastal Zone Management programs provide important data about the coastal zone. However, one challenge is that funding is not sufficiently available or guaranteed for the long term. Overall, he stressed that data sharing is very important since more than just federal agency information is needed if we are to accurately measure the nation's coastal health. It also is imperative to make indicators part of the day-to-day mission and understand data gaps so that they can be addressed.

David Gordon

Fish and Wildlife Biologist, USFWS

Dr. Gordon discussed the USFWS' access to ocean data imbedded in other programs such as the wetland survey. In addition, there are over 160 wildlife refuge areas available for data collection. He then focused on indicator organization, and cited mission and priorities, legal mandates and authorities, internal versus external needs, accountability and uncertainty as factors to be considered when developing indicators and indicator criteria. The debate about internal versus external user needs is important. As an example, the coastal refuges need good map data to examine regional and local trends, but the national wetlands group is required by mandate to map on a national level, so there is tension over what gets done and in identifying priorities. Accountability also becomes an issue as we need to differentiate between what we can do and what we should do. Finally, it needs to be determined if the capability even exists to collect the necessary data, regardless of whether there is a mandate.

Panel Discussion

The challenges of reporting nationally about the state of the coastal ecosystem were briefly discussed following the panel presentation. Some participants argued that pressures on the system, which cause or at least strongly influence changes in the ecosystem state, should somehow be captured in the indicator suite. Others maintained that while this was important, simply monitoring the health of the ecosystem was a large enough objective in and of itself.

Some suggestions for improving coordination among agencies and states included: 1) developing a common language for all federal agencies to use so they can collect and report data in a consistent manner; 2) identifying leverage points and case studies to more accurately reflect what is being measured at the local and regional levels to assess ecosystem health; 3) identifying international linkages and building partnerships to promote more coordinated data collection; 4) finding new and better ways to actively engage grassroots organizations and reflect local knowledge through newly defined indicators; and 5) identifying the "best" messages and packaging them in such a way that tells a story and provides suggestions for what can be done to improve coastal condition.

In addition, the group began discussion about the target audience. It was acknowledged that the key audiences include decision makers, leaders (e.g., Congress) and an informed public, with the goal to develop indicators that can influence policy decisions.

Working Group Discussions

Participants were broken into five working groups. In order to promote effective working group discussions, participants were provided with background materials to read in preparation for the workshop. In addition, they were given a draft framework table (Appendix A) to complete which included a list of key management issues, management questions, common indicators in use and emerging indicators to assess ecosystem health and some suggestions for possible core indicators in relevant categories (i.e., Pollution Indicators, Land/Water Interface, Biological and Physical Indicators, Climate Change Indicators and Social Economic Indicators). A draft list of Indicator Selection Criteria was also provided (Appendix A). Working Groups were asked to modify these draft documents as needed.

Some working groups opted not to use the draft framework table and criteria but used other methods to formulate their ideas for national core coastal indicators. Recognizing that some areas of expertise were not adequately represented in all working groups and in order to efficiently accomplish their respective assignments in the allotted time, some working groups opted to narrow the focus of their respective discussions. This resulted in some topics not being discussed and thus not reflected in the resulting set of core indicators identified by each working group even though they might be of equal importance. For instance, while not thoroughly discussed, identifying and monitoring sources of pollution from land is of utmost importance (e.g., the link between land use cover, water quality issues and influences of agriculture, green development and stormwater). It was pointed out that there are national data sets on terrestrial habitat and uplands collected by agencies such as the U.S. Forest Service, which should be integrated with water quality data to better identify sources of pollution and links between land-based activities and coastal water condition. In addition, it was recognized that vulnerability (e.g., human coastal communities vulnerability as a result a storm event) is difficult to measure but should somehow be captured in an indicator. Another suggestion made was that disease outbreaks in fish might be identified through the marine mammal database and used as a further measure of coastal ecosystem health.

Working Group 3, which focused on biological and physical indicators, opted not to identify a core indicator for monitoring the distribution and abundance of sea and shorebirds due to the challenges of monitoring highly migratory species, although some, more sedentary species were identified as common indicators for ecosystem health. It was pointed out that there are significant amounts of marsh bird data that might be useful in the development of a resident bird species indicator. Working Group 3 also opted not to discuss humans as they thought it would be captured in other working group discussions focusing on land-use and socio-economic indicator development. However, it was pointed out that as changes in coastal water and ecosystem condition occur, the health of traditional human communities also is influenced and should be monitored. For instance, the change in number of coastal and marine industry related jobs may be relevant but so are changes in job mix. In addition, Working Group 1, which focused on pollution indicators, did not spend much time on air quality as they lacked expertise on this topic within their group of participants. However during the plenary discussion, it was stressed that atmospheric deposition is a factor in effecting water quality especially when considered cumulatively with other factors. While Working Group 4, which focused on climate change indicators, did not spend much time discussing changes in sea temperature, this issue was recognized by the broader group of workshop participants as important within the context of understanding future climate change impacts on the coastal zone. Working Group 5, which focused on human use indicators, also chose to limit its discussions to human uses that are affected by coastal ecosystems rather than human effects on coastal ecosystems as they felt that there had been much more discussion of the latter through previous efforts. Working Group 5 also recognized that aquaculture would be an increasingly important issue in the future, but for now included aquaculture under the collective heading of fishing.

A summary of each working group discussion can be found in Appendix B. In addition, management issues and indicators derived from working group discussions are included in the workshop key findings on page 6.

Discussions on Communicating Coastal Condition to Target Audience

On the second day of the meeting much of the discussion focused on the importance of properly identifying the target audience and communicating what the indicators mean in terms of national coastal condition. Congress, including congressional staff and members, as well as the executive branch, specifically agency heads, and the general public, were viewed as the primary audiences. However, it was pointed out by some participants that the approach for reaching these groups would be different. Some felt that one national report could not achieve the goal of reaching these different audiences. A suggestion was made that perhaps a national report could be produced for Congress, governmental agencies and the scientific/non-governmental community and that a consolidated fact sheet (such as the one currently produced to support the NCCR) could be generated to help educate the general public about the coastal condition. It was stressed that in order to reach the public, the message needed to be simple and able to be relayed through the media via a “sound byte.”

There was general support for development of a strategic marketing plan to convey the message to target audiences. A number of secondary audiences also were identified during the working group discussions. These included, teachers, advocates, NGOs, state and local governments (e.g., governors, governors’ organizations, interagency groups, zoning/planning boards and staff, elected officials, coastal zone management agencies, marine fisheries councils, and regional partnerships). It also was stressed that coalitions advocating for the report must be built to help move the coastal ocean conservation and management agenda forward.

Several participants expressed limitations with using the NCCR to monitor and report on coastal condition at the national level. The primary concerns regarding the report included: 1) the infrequency of sampling which does not reflect year round condition of coastal waters (i.e., since the 1980’s, EPA’s Office of Research and Development (ORD) has used a probability-based sampling design to provide a statistically-valid basis for determining the health of the nation’s estuaries, streams and lakes in selected geographic regions and surrounding landscapes around the country); 2) reporting of national indicators does not adequately reflect actual indicators which need to be measured at local scales; and 3) funding cuts in ORD could mean that the office would no longer be able to produce the NCCR. In particular, some participants noted that their efforts at this workshop to better define indicators may be irrelevant if there is no funding to implement them. Participants were reassured that EPA’s Office of Water would continue to produce NCCRs to help satisfy EPA’s obligations under the congressionally mandated Government Performance and Results Act.

Participants were asked to identify means for either improving the NCCR or to propose other options for reporting on the condition of national coastal waters. Key options were either expanding the NCCR or producing a new report which incorporates, inter alia, 1) socio-economic indicators; 2) case studies or regional/local “stories” (e.g., the Florida Everglades, Chesapeake Bay, Puget Sound etc.) which the Congress and the public could relate to and may help evoke concern and a willingness to take action to help protect these resources; 3) local knowledge; 4) demonstrations of links to loss of human services to foster interest and concern (e.g., high hypoxia due to fertilizer use may lead to lower flatfish catches the next year); and 5) suggestions for what people can do to protect resources to empower people and avoid immobility due to “terror syndrome, fear of death.”

One working group provided a template for a national report based on the notion of telling a story to the public (e.g., Great Lakes 2007 might provide some ideas through an anecdotal approach and the Chesapeake Bay and Georgia Coastal Development Program have effective monitoring programs which could serve as interesting initial case studies.). The report structure would include an executive summary, a section on core messages (e.g., population, GDP, fisheries landings and value, coastal recreation and change by region etc.) and a section on highlights of where the big changes are occurring nationally. Another working group identified means for conveying the data including 1) illustrating messages with maps and interactive mapping; 2) using numbers and scores to express the extent, trends and status as they relate to the indicators; 3) reviewing existing reports for displays that work (NOAA Eutrophication report, State of the Puget Sound Report, Puget Sound Georgia Basin Ecosystem Indicators Report); 4) generating a National Report Card that averages regional scores and a map with a color code for finer scale analysis (e.g., the Joint Ocean Commission Initiative (JOICI) Report Card); and 5) providing examples of management mechanisms that affect each of the management questions. This would demonstrate effects in a given area on a given scale.

It also was suggested that rather than producing an entirely new report, the NCCR might be retained with the addition of regional efforts or more detailed profiles of state, regional or grassroots efforts to develop and use indicators to tell a story about the condition of coastal waters (i.e., provide case studies of local successes and failures). The NCCR could present a national map with indicators of national coastal condition but also assign some value to these indicators. This could be accomplished by applying a stop light approach which shows variability nationally in standards for what is good, fair or poor and what data points are fed into the rating for a given area.

In addition, three agency leaders from the EPA, NOAA and the NPS briefly spoke about their agency's viewpoint and goals for the NCCR (or in Gary Matlock's case, his personal viewpoint).

Suzanne Schwartz

Deputy Director – EPA Office of Oceans, Wetlands and Watersheds

The EPA has found that when trying to address environmental issues, the first question from the public is always "how do you know there is a problem?" Monitoring and measurement are essential in addressing this question, because without them, problems cannot be identified and properly conveyed. However, the agency wants to ensure that it has defined the most appropriate indicators so it continues to seek public input, like through this workshop.

In the 1980s, only 40% of the nation's waters were assessed, and that was the basis for national reports. Since the NCCRs were instituted, 100% of the Nation's contiguous coasts have been randomly assessed. Two of the top priorities in the agency are better monitoring and data.

For the fourth NCCR report due out in 2010, the states are going to collect the majority of the data. The target audience for the report includes everyone from the White House to the public.

Gary Matlock

Director – NOAA National Centers for Coastal Ocean Science *Personal viewpoint**

Dr. Matlock stressed that the NCCR is not an EPA-only report; NOAA is a co-author. This report does what the public needs in that it provides a scientific, official, integrated report of the condition of the coast. No other report does this.

However, one caveat is that the overall "fair" rating of the coasts primarily considers water quality. This is good because of the Coastal Pollutions Monitoring Act that requires federal agencies to report on water quality around the nation. As such, in Dr. Matlock's opinion, the primary audience for this report is Congress to satisfy the reporting requirement.

It also is important to include statements about whether the state of the coast is meeting society's desired uses (e.g., in the NCCR, case studies have or will explore Galveston Bay and Narragansett Bay). The NCCR should serve as a report card on accomplishing goals that have been set by federal agencies for managing the national coastal condition. It was his opinion that the NCCR should also provide recommendations for what can be done to improve coastal condition. Other reports, such as the Heinz Center's State of the Nation's Ecosystems Report, do not provide analysis/assessment. Instead, they draw the line at presenting just indicator data and trends.

Gary Davis

Ocean Branch Chief – NPS

The National Park Service is 20 years into developing a monitoring program for its parks. The service wants to know how the ecosystem works and tries to detect early warning signals of change. Their selection of national indicators (vital signs) for the parks is now underway. Some parks have been monitoring indicators for nearly two decades, but others are just starting to use indicators. In addition, NPS, along with the Integrated Ocean Observing System, NMS, National Wildlife Refuges and NERRs are partnering to make a seamless system of parks in the United States.

A possible next step would be to include national parks or other local/regional coastal examples as a case study in the NCCR (e.g., the Everglades and Chesapeake Bay, etc.). The data are available for national parks and they

resonate with people. Telling stories about the way people and nature interact on the coast in the national parks will help promote stewardship.

Proposed Future Action

During plenary discussions, suggestions for improving interagency communication and data sharing, streamlining data collection and reducing the burden of reporting requirements were discussed. Several useful ideas emerged, and the summary is presented here. In addition, the next steps to address these suggestions were compiled and reported in the form of a six-month Action Plan.

Suggested Action 1: Develop a communications strategy with the help of public relations experts for explaining what coastal indicators mean to Congress and the general public

- Identify methods to visually convey information (e.g., maps, interactive maps, etc.)
- Draw from experiences/report presentations of other efforts to communicate coastal condition
- Have CSO or public relations experts survey audiences to identify current perceptions and best methods of communicating the message about the state of the coast to target audiences
- Convene a follow-up workshop among governmental agency public relations or communications staff to discuss methodology for outreach

Suggested Action 2: Achieve buy-in from agencies and partners through a series of nationwide outreach meetings or conducting a user group survey

- Identify cautions/issues of interpretation in developing and using indicators
- Determine federal/state/local management needs and coordinate federal programs and data collection
- Determine data gaps that prohibit tracking key indicators and coordinate federal and non-federal efforts to address gaps
- EPA might need to enhance its “Surf Your Watershed” website to allow for aggregation of data at broader state/regional level. Currently the site provides information by zip code or watershed
- Determine what indicators are most useful for telling a story about coastal condition which can evoke human concern and willingness to take action
- Establish a national network of individuals/groups to share indicator development and implementation experiences
- Advocate use of USGS website which contains tested monitoring protocols for state/local efforts
- Institutionalize and streamline indicators that have direct management use
- Build in a mechanism for periodic user or audience feedback to ensure indicators remain useful over time
- Consider socio-economic and ecological indicators to move toward a more comprehensive assessment of coastal resources, uses and values

Six Month Action Plan

- Mid June, 2007: Final workshop report will be distributed to participants and posted on the event website.
- July 23, 2007: A session will be facilitated at the Coastal Zone 2007 Conference to gain ideas for prioritizing the indicators from the workshop.
- May – October, 2007:
 - Federal agency participants will vet the workshop ideas and indicators with others within their respective agencies to gain additional input and to expand agency participation in further developing specific indicators and in identifying possible data sources. Agency participants will also discuss options for a data/information sharing mechanism and for a practitioner network to improve communication between people working on coastal indicators.
 - State, local, and NGO partners will be called on to assist in further developing specific indicators, identifying possible data sources and shaping a mechanism for data/information sharing among indicator efforts and experts.